

Conserving Great Lakes Alvars
Final Technical Report of the
International Alvar Conservation Initiative

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compiled by

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on behalf of the

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Conserving Great Lakes Alvars

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Executive Summary

Alvar ecosystems are grassland, savanna and sparsely vegetated rock barrens that develop on flat limestone or dolostone bedrock where soils are very shallow. Almost all of North America's alvars occur within the Great Lakes basin, primarily in an arc from northern Lake Michigan across northern Lake Huron and along the southern edge of the Canadian Shield to include eastern Ontario and northwestern New York state. Most types of alvar communities are globally imperiled, and they support several globally rare species as well.

The International Alvar Conservation Initiative is a collaborative effort aimed at providing a unified, consistent approach to understanding and conserving this rare and vulnerable Great Lakes ecosystem. The Alvar Initiative has been coordinated by the Great Lakes Program of The Nature Conservancy (TNC). Individual projects related to the Initiative were coordinated through annual meetings and ongoing discussions of the Alvar Working Group, a forum involving over 50 collaborators from government and non-government organizations and universities.

Highlights of Results

- ▶ an unprecedented, high-quality information base for future decisions about priority actions for alvar conservation across the Great Lakes basin by planners, agencies, and non-government organizations
- ▶ an enhanced understanding of several aspects of Great Lakes basin biodiversity, including the discovery of several new species and many new sites for rare and endemic species
- ▶ a broadly-accepted, consistent framework for evaluating alvar conservation priorities within the 27,200 acres of alvar habitats across the Great Lakes basin
- ▶ documentation of 34 high-priority sites with an assessment of protection urgency for each, as well as identification of 49 other significant alvar sites across the basin
- ▶ a much improved understanding of key ecological factors sustaining alvars, threats to their viability, and appropriate management and restoration practices
- ▶ over 8700 acres of high-priority alvar sites now in the process of permanent securement through acquisition, government designation, and conservation easements
- ▶ direct education of over 50 private landowners of 17,000 acres of alvar about the value of these imperiled habitats

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- ▶ a dramatic increase in awareness of the need for alvar conservation among agency and non-profit staff, consultants, academics, naturalists, and the general public
- ▶ mechanisms to maintain the conservation momentum created by the Alvar Initiative, and to monitor future progress
- ▶ documentation of a model collaborative approach to conservation that could be applied successfully to other Great Lakes habitat types.

Project Results

1. An accurate range-wide assessment of alvar distribution and conservation status

- ▶ Botanical field surveys were completed for 103 alvar sites, and data reviewed for a total of 121 alvar sites with an extent of approximately 27,200 acres.
- ▶ Field data was analyzed from 120 observation points and 85 quantitative plots to develop an alvar community classification system including 13 alvar community types and 4 related types. Each type was described and assigned a global rarity ranking, and each occurrence assigned a conservation priority ranking.
- ▶ New data was collected on target vascular plant species, non-vascular plants such as lichens, mosses, and algae, terrestrial molluscs, and target insect groups involving over 600 species. New sites were found for 10 globally rare land snails, and a total of 26 proposed new snail species are being described.

2. Documentation of priority sites for long-term protection.

- ▶ Alvar sites were evaluated on the basis of four criteria, including sites with the largest diversity of alvar community types, sites which collectively best represent each of the alvar community types, sites which best represent the diversity of alvar communities within each ecoregion, and sites with globally rare species.
- ▶ 34 “multiple-value sites” were identified as meeting more than one of these criteria, along with an additional 49 other significant alvar sites. More detailed information on individual sites has been provided in reports for NY, OH, MI, and ON, and in the Heritage Programs’ computerized databases. The multiple-value sites include:

Michigan: Bass Cove
 Garden SE Glade
 Huron Bay

New York: Chaumont Barrens
 Limerick Cedars
 Lucky Star

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Ontario:	Maxton Plains	Ohio:	Three Mile Barrens
	Thunder Bay Island		Marblehead (Lakeside)
	Belanger Bay		Burnt Lands
	Cape Croker		Carden #1
	Carden #3a		Carden #5
	Clapperton Island		Dyers Bay/Brinkman's Corner
	East Side Quarry Bay		Foxy Prairie
	George Lake		Gretna
	Hayesland-Flamborough		LaCloche Area
	Misery Bay		Pendall Lake
	Pike Bay		Pine Tree Harbor
	Salmon River		Scugog Lake
	Stone Road		Taskerville
	West of Lynn Point		West of South Baymouth

- ▶ Based on knowledgeable local input, securement urgency and management urgency rankings were provided for all multiple-value sites, showing that just over half of these sites have high urgency for protective actions.

3. A working knowledge of how alvar ecosystems function.

- ▶ Detailed studies of surface and groundwater hydrology were carried out at Chaumont Barrens (NY), and monitoring of seasonal alvar hydrology and the effect of ruts at LaCloche alvar (Manitoulin, ON) and Chaumont Barrens.
- ▶ Analysis of field data and land use history information was completed to assess the role of fire in alvar ecology.
- ▶ Long-term research plots have been established at 6 alvar sites in ON and NY to monitor the effects of livestock grazing and deer browsing on alvar ecology.
- ▶ Analysis of field data from observation points examined the role of exotic (non-native) species, and some site-specific research on control techniques for European buckthorn was also carried out.
- ▶ An overview of threats to alvar habitats across the basin was provided, with an analysis of where each threat is concentrated. This overview noted that over half of the multiple-value alvar sites have high or very high securement or management urgency ratings. Significant threats include quarrying, residential and related development, all-terrain vehicle and off-road vehicle use, heavy grazing and browsing, exotic species, plant collecting, logging and forestry, and waste dumping and vandalism.

4. Conservation strategies for the protection and stewardship of alvar ecosystems.

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Approximately 100 participants took part in the June 1998 Alvar Conservation Workshop in Tobermory, Ontario. Seven types of conservation activity were noted as already underway for alvars within the Great Lakes basin:

- ▶ Protective public ownership within the Bruce Peninsula National Park, provincial and state nature reserves, and other state lands..
- ▶ Protective NGO ownership including TNC alvar holdings in New York and Michigan and Federation of Ontario Naturalists (FON) reserves on the Bruce Peninsula and Pelee Island. Several other major acquisition projects are currently underway.
- ▶ Private land stewardship, which involves an NGO working cooperatively with private landowners to encourage voluntary conservation, involving over 50 landowners and over 17,000 acres during the course of the Alvar Initiative.
- ▶ Joint planning for protection, involving several groups and agencies, on Manitoulin Island, the Carden Plain, and elsewhere through TNC's ecoregional planning process.
- ▶ Integration of alvar sites into the land use planning system, particularly in Ontario, where the FON has undertaken a provincial alvar theme study to identify additional ANSI lands that must be considered in land use decisions.
- ▶ Site management and restoration activities including construction of boardwalks and interpretive trails, experimental techniques to control non-native plants, controlled burns, and restoration of former quarry sites through the seeding of lakeside daisy.

Priority actions recommended for alvar conservation include:

- ▶ Continued conservation leadership through the individual programs of TNC, FON, and Nature Conservancy of Canada (NCC), and through a joint alvar conservation steering committee to oversee a part-time Alvar Specialist.
- ▶ Developing and implementing action plans for the conservation of high priority alvar sites.
- ▶ Broadening and strengthening support among private landowners, the native community, conservation practitioners, and the general public.
- ▶ Filling knowledge and research gaps in a number of specific areas.

5. Increased awareness of the uniqueness and value of Great Lakes alvars.

- ▶ The state summary reports for NY, OH and MI, and the upcoming alvar theme study for Ontario, address a technical audience.

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- ▶ A glossy full-color booklet and poster being produced by FON will provide information for the general public.
- ▶ Alvar Initiative outcomes include at least 17 magazine and newsletter articles, 14 technical reports, theses and published journal articles, 4 stewardship booklets oriented to private landowners, and presentations at 5 conferences.
- ▶ Other media coverage including TVO Down to Earth, Great Lakes Radio Consortium, and Toronto Star newspaper.

6. A mechanism for monitoring the status of alvar elements and ecosystems.

A structure to support future monitoring and assessment is part of the responsibilities of a proposed joint alvar conservation steering committee. This follow-up will be included in the duties of an Alvar Specialist, through reports on progress to bi-national conferences or through biennial update reports, and through a twice-annual electronic newsletter.

7. A replicable model for regional collaboration in the conservation of biodiversity.

An analysis of the model provided by the International Alvar Conservation Initiative includes an outline of the process steps, a discussion of key ingredients for success, and criteria to identify other ecosystem types which might benefit most from such a collaborative approach.

1.0 Introduction

1.1 Introduction to Alvars

The Great Lakes basin has a rich ecological legacy, including many communities and species of global significance. Among the most remarkable of these is a cluster of community types and associated species known collectively as alvar.

While various alvar communities can look quite different, they all share several key characteristics:

- they occur on flat limestone or dolostone bedrock where soils are thin or absent;
- they are naturally open landscapes, with tree cover absent or severely restricted;
- they are all subject to seasonal drought, and some types to seasonal flooding;
- they have a distinctive set of plant species and characteristic vegetation associations; and
- they contain many species that are rare elsewhere in the Great Lakes basin and some species endemic to the basin, including plants, terrestrial molluscs, and invertebrates.

A more technical definition of alvars, developed for the purposes of the International Alvar Conservation Initiative, states:

“Alvars are natural communities of humid and sub-humid climates, centered around areas of glaciated horizontal limestone/dolomite (dolostone) bedrock pavement with a discontinuous thin soil mantle. These communities are characterized by distinctive flora and fauna with less than 60% tree cover, that is maintained by associated geologic, hydrologic, and other landscape processes. Alvar communities occur in an ecological matrix with similar bedrock and hydrologically influenced communities.”

(Alvar Working Group 1995)

Alvars are named after structurally similar systems in northern Europe, where they occur in the Baltic region of Sweden and Estonia as well as in a small area in western Russia (Rusch 1996). The largest continuous alvar landscape in that region is on the Swedish island of Oland, where human activities and

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grazing have occurred since the first centuries A.D. Alvar vegetation in the Baltic region has been considered to be a unique steppe-like phytogeographic formation which resembles true steppes occurring in eastern Europe and Asia (Titlyanova et al. 1988).

A large area of limestone pavements and ridges with vegetation communities similar to alvars has also been documented along the western coast of Ireland in an area called The Burren (D'Arcy and Hayward 1997). This area is floristically diverse, with an interesting mix of alpine, arctic, and Mediterranean plants, including many rarities. Over 350 species of lichens are found on the shallow limestone of the area.

In the Great Lakes region, alvars occur in a series of clusters just south of the contact line with the granitic uplands of the Canadian Shield and in a few small isolated areas to the south. Approximately 64% of Great Lakes alvar area occurs within Ontario, with about 16% in New York state, 15% in Michigan, and 4% in Ohio. Smaller areas occur in Wisconsin and Quebec. These updated figures contrast with earlier estimates that over 90% of the alvar area was in southern Ontario (Catling and Brownell 1995).

In the eastern United States, limestone openings similar to alvars known as cedar glades occur in Tennessee, Alabama, and Georgia (Baskin and Baskin 1985), but these communities occur on unglaciated, often sloping terrain, and they have more endemic species and a different floristic composition (Catling and Brownell 1995). To the west of the Great Lakes, alvars grade into dry prairies over limestone or calcareous gravel (Curtis 1959; Erickson et al. 1942). Similar habitats with many species characteristic of alvars also occur to the north within the boreal forest, where they are referred to as "limestone barren" (Brownell 1998).

While all Great Lakes alvars occur on shallow limestone or related calcareous bedrock, a series of different bedrock geological types from the Devonian, Silurian, and Ordovician series are found underlying alvar sites (Brownell 1998). These different types can produce different patterns of local topography, cracks and crevices, and surface weathering and erosion. Limestone and related rocks vary widely in their hardness and the rate at which they weather into soil. These factors, as well as local climatic conditions, may contribute to differences in the plant communities found on various sites.

Alvar habitats have likely always been sparsely distributed within the Great Lakes region. One estimate of their extent in southern Ontario prior to settlement suggests a total potential area of 1100 to 1500 km² (Catling and

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Brownell 1995). A significant portion of this original extent has been lost, although the exact degree of loss may never be known because the boundaries of pre-settlement alvars are often unclear. This project documented approximately 11,200 hectares (112 km²) of remaining alvar habitat of reasonable quality across the entire Great Lakes basin. Much of the remaining area has been substantially degraded through the modification of alvars and surrounding woodlands by agriculture or other human uses.

From a conservation perspective, alvar communities command interest because of their rarity, their distinctive character, and their large numbers of rare species. The bedrock pavements, grasslands and savannas of alvar ecosystems are characterized by an unusual blend of boreal, southern, and prairie species – relicts of the cold post-glacial environment and the warmer, drier period which followed. Many species that occur in alvars are disjuncts, far from their normal range but able to survive in shallow soils and harsh conditions. These are often species that have a high degree of confinement to alvar sites; for example, 54 vascular plants have the majority of their occurrences in Ontario on alvars (Catling 1995).

Several organisms such as the endemic lakeside daisy (*Hymenoxys herbacea*) have evolved to survive only in this special environment. Many other alvar species are of global, regional, or state/provincial significance. For example, 43 plant species regarded as rare in Ontario occur on alvars (Catling and Brownell 1995). Almost all types of alvar communities are considered globally imperiled or threatened.

To further highlight the significance of alvars, Catling and Brownell (1995) pointed to three other factors:

1. Genetic Diversity

Some elements of the biodiversity found in alvar communities, flora, fauna, and germplasm are potentially useful for future improvement or diversification of cultivated crops. For example, we may benefit by looking at adaptation to drought in characteristic alvar plants with cultivated crop relatives, such as wild strawberries (*Fragaria virginiana*), Saskatoons (*Amelanchier alnifolia* and other species), cherries (*Prunus pumila* var. *americana*, *P. virginiana*), and plums (*P. Americana*, *P. nigra*).

2. Research Potential

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Alvars are important habitats for research into understanding past vegetation and the impacts of climatic change on vegetation, the effects of environmental changes involving drought, and research in the fields of evolution, taxonomy, and biogeography. The discovery of new species of insects (e.g. Brunton 1986), snails (Grimm 1995), and a new species of plant (Catling et al 1993) from alvars reinforces this research potential.

3. Ecotourism

Alvars can serve as an ecotourism attraction, bringing economic benefits to local communities. For example, the wildflower displays on the Marblehead Peninsula alvars prior to quarry development attracted busloads of people. Currently, sites on the Bruce Peninsula are very popular with naturalists and photographers, and other alvar locations such as Manitoulin, Carden Plain, and Chaumont Barrens are experiencing increasing visitation.

1.2 The International Alvar

Conservation Initiative and Alvar Working Group

The International Alvar Conservation Initiative is a collaborative effort to provide a unified, consistent approach to understanding and evaluating alvar ecosystems and developing basinwide strategies to ensure their protection and stewardship.

Major funding for the Initiative was provided by the Great Lakes Protection Fund, the C.S. Mott Foundation, The Nature Conservancy's Rodney Johnson Stewardship Endowment Fund, the U.S. Environmental Protection Agency Great Lakes National Program Office, and a wide range of in-kind and financial contributions from state Natural Heritage Programs, the Ontario Natural Heritage Information Centre (ONHIC), Couchiching Conservancy, and other government agencies and non-government organizations (NGOs).

Overall coordination for the Initiative was provided by The Nature Conservancy (TNC)'s Great Lakes Program in Chicago, initially by Science Director Sue Crispin, and in the last year by Ron Reid, a contracted consultant. Carol Reschke, a TNC Community Ecologist, acted as technical and research coordinator throughout the project. As the Alvar Initiative evolved, the Federation of Ontario Naturalists also took on a coordinating role for many of the activities within Ontario, and ONHIC staff played a key role in several aspects.

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At the heart of the Alvar Initiative is the Alvar Working Group, a forum for information sharing, priority setting, and coordination of basinwide activities. The Alvar Working Group began with staff from TNC's Great Lakes Program, two TNC state chapter offices, three Natural Heritage Programs, Ontario's Ministry of Natural Resources (OMNR), the Federation of Ontario Naturalists (FON), Nature Conservancy of Canada (NCC), and several independent scientists. Through word of mouth, new members with an interest in alvars were added to establish a group of over 50 collaborators:

- 10 from Natural Heritage Programs in Ontario, New York, Ohio, Michigan and Wisconsin
- 10 from government resource management agencies in Ohio, Ontario, and Canada
- 14 from non-government organizations including TNC, FON, NCC, and Couchiching Conservancy
- 11 university-based researchers, including graduate students, from 8 institutions
- 7 individual researchers/consultants

A list of individual collaborators and their affiliations is included in Appendix 4.

Much of the interchange of information and viewpoints among these collaborators took place by e-mail, voice mail, and fax, and occasionally by telephone conference calls among smaller groups. The Alvar Working Group met in person on five occasions:

July 1994 in Kingston, Ontario

April 1995 in Windsor, Ontario

March 1996 in Brantford, Ontario

June 1997 at Cape Chin, Ontario

June 1998 in Tobermory, Ontario

In concert with the final Alvar Working Group meeting, the 1998 Tobermory Workshop was expanded to approximately 100 participants, including alvar landowners, additional agency and NGO staff, and interested conservationists. This event was designed to impart information about the findings of the Alvar

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Initiative as well as assist in setting priorities to identify alvar conservation targets.

An evaluation of the collaborative process used by the Alvar Working Group is included in Chapter 6 of this report.

The International Alvar Conservation Initiative was designed with seven principal objectives, under which a wide range of work activities and projects were organized.

Objective 1: Compile an accurate rangewide assessment of the distribution, character, diversity, condition, threats, and ecological requirements of alvar systems within the Great Lakes basin.

Activities to meet this objective included field surveys of 103 sites across the Great Lakes basin, including 27 sites in northern Michigan, 10 in New York, several in Ohio, and the remainder in Ontario. Additional information was reviewed from previously surveyed sites across the Great Lakes basin, including those in Ohio, Wisconsin, Illinois, and Quebec. Information on a target list of rare plants was recorded, along with partial surveys for target groups of fauna, including terrestrial molluscs, butterflies, leafhoppers, tiger and ground beetles, sawflies, and orthopteroids. Field information was also collected on such stressors as fire, deer browsing, cattle grazing, evidence of flooding, and presence of exotic weeds.

As described in Chapter 2 of this report, results of these field studies were analyzed to develop an alvar classification system to serve as a framework for identifying conservation targets.

Objective 2: Document a series of high quality alvar ecosystems that represent the best opportunities to ensure long-term protection of the full range of alvar diversity and function, and prepare recommendations for their protection.

An initial analysis of alvar sites was based on ranks for the size, condition, and landscape context for each alvar community occurrence, as shown in Table 2. The resulting list of 176 high priority alvar community occurrences was further evaluated based on criteria developed at the Tobermory Workshop, as described in Chapter 5. As a result, 34 “multiple-value” sites which met several of these criteria were identified as being of highest conservation priority, and a protection and management urgency rank was established for

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each. A total of 49 additional significant sites were also listed as important conservation priorities.

Detailed information on each of the alvar occurrences has been documented in state and provincial Natural Heritage Programs' computerized databases. Information on individual sites has also been summarized in an Alvar Theme Study for Ontario and in state summary documents for New York, Ohio, and Michigan, as described in Chapter 7.

Objective 3: Develop a working knowledge of the ecological conditions and processes essential to the maintenance of alvar systems, major threats, and techniques available to address those threats.

A series of projects was initiated to better understand key ecological processes that may be critical to alvar conservation: hydrology and soil moisture regime, invasion by exotic species, the effects of browsing and grazing, and the role of fire. As well as drawing on the field information from surveyed sites, these processes were examined in more detail by specific research projects at representative sites. A summary of results from these studies is presented in Chapter 4.

Objective 4: Develop conservation strategies for the protection and stewardship of alvar ecosystems, in partnership with key institutions from public and private sectors at the regional, state/provincial, and local levels, and support for the implementation of those strategies.

A wide range of conservation activities in alvar sites has been initiated over the past four years, most with support and encouragement from the Alvar Initiative. These activities are described in Chapter 5.

Objective 5: Increase awareness of the uniqueness and value of Great Lakes alvar systems among scientists, policy makers, landowners, and the general public through scientific and interpretive materials produced, and through the popular media.

The discussions of the Alvar Working Group and the new information generated by field inventories and research projects have created an explosion of interest in alvars among scientists and conservation practitioners. This audience is also being reached through the state summary reports, the Ontario alvar theme study, a special alvar session at the 1998 Natural Areas Conference, and publications in scientific journals (see Chapter 7).

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A more general audience is being addressed through popular articles on alvars in magazines such as *Seasons* and *Wildflower*, through alvar stewardship reports developed for landowners in several areas, through a glossy alvar booklet and poster currently being developed, and through radio, television, and newspaper coverage of alvars.

Objective 6: Develop a mechanism for monitoring the status of alvar elements and ecosystems and, collectively on a regular basis, assessing new information, progress towards objectives, and making course corrections to improve the success of alvar conservation strategies.

This objective was added by the Alvar Working Group at their 1995 meeting, with the intent that the findings of the Alvar Initiative should not remain static but instead represent the beginnings of a dynamic conservation process that responds to new information and changing situations. The network of active partnerships created by this project will form the foundation for this ongoing process. Specific recommendations for this monitoring and adapting role are included in Chapter 5.

Objective 7: Develop a replicable model for regional collaboration in the identification, understanding, and conservation of biodiversity, utilizing an ecological approach and building on existing institutional capacity.

An analysis of the ingredients for success and lessons learned from this project is included in Chapter 6. Information about the Alvar Initiative process has been presented to workshops on Great Lakes Islands and at the 1998 Natural Areas Conference. It also has been referenced as a model at the bi-national SOLEC 98 Conference and in TNC's U.S./Canada Working Group Report.